

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of :  
OTANI ET AL. : GROUP ART UNIT: 1794  
Serial No. 10/595,914 :  
Filed: May 19, 2006 : EXAMINER: KRUPICKA, ADAM C  
For: ANISOTROPIC CONDUCTIVE :  
ADHESIVE SHEET AND COUPLING :  
STRUCTURE :

D E C L A R A T I O N

Honorable Commissioner for Patents  
Alexandria, VA 22313-1450

Sir:

I, Akira OTANI, a Japanese citizen, c/o ASAHI KASEI  
EMD CORPORATION, 1-105 Kanda Jinbocho, Chiyoda-ku, Tokyo 101-  
8101, Japan, declare:

That I am a joint inventor of the above-identified  
application;

That I am familiar with the invention of the above-  
identified application and the prosecution history of the  
application;

That I have read and understand the official action  
issued against the above-identified application  
on April 14, 2009 and the prior art references cited therein;

That in order to prove, based on a quantitative  
analysis, that even if conductive particles can be placed  
substantially in a rate of one particle per particle site in  
a tool having a plurality of dimples (hereinafter referred to  
as a dimpled tool) by conducting an experiment in accordance  
with the disclosure of Connell et al. US 2001/0008169 A1  
(hereinafter referred to as Connell), most of the particles  
cannot be transferred to the adhesive layer and the actually  
obtained adhesive sheet does not meet the limitations: "90%

or more of the conductive particles are present without contact with other conductive particles" and "the average particle distance between adjacent conductive particles is at least once but five times or less the average particle size and not greater than 20  $\mu\text{m}$ ", according to claim 1 of the present application, I conducted the following experiments:

#### Experiment and Result

##### (1) Preparation of dimpled tool

An anisotropic conductive adhesive was made according to paragraph 0046 of Connell. This tool had a plurality of dimples which each had a diameter of 1.5 times the average particle size of the conductive particles and a depth of 1.0 times the average particle size of the conductive particles so as to place one conductive particle per particle site of the dimples.

Specifically, the dimpled tool was made as follows. The preparation of the dimpled tool is illustrated in the schematic picture of Fig. 1 attached hereto.

##### (Substrate)

An alkali-free glass plate of a dimension of 200 mm x 150 mm and a thickness of 0.7 mm was washed with water and dried, and then used as a glass substrate.

##### (Laminate)

Dry film resist UFG-052 manufactured by ASAHI KASEI ELECTRONICS (three-layer structure of a polyethylene terephthalate film, a photopolymerizable resin composition layer and a polyethylene film; thickness of the photopolymerizable resin composition layer: 5  $\mu\text{m}$ ) was laminated onto the glass substrate with a hot roll laminator (AL-70 manufactured by ASAHI KASEI CORPORATION) at a roll temperature of 100°C, while the polyethylene film was peeled off the dry film resist. The roll pressure of the laminator was 0.2 MPa on an air gauge display. The laminate speed was 1.0 m/min.

##### (Exposure)

The photopolymerizable resin composition layer was exposed through a mask film (glass chrome mask) to light of  $30 \text{ mJ/cm}^2$  from a super high pressure mercury lamp (HMW-801 manufactured by ORC MANUFACTURING CO., LTD.).

(Development)

After the polyethylene terephthalate film was peeled off the photopolymerizable resin composition layer, the latter was immersed into 0.05% aqueous potassium hydroxide solution at  $23^\circ\text{C}$  for 60 seconds to dissolve and remove unexposed portions of the photopolymerizable resin composition layer. Thus, a dimpled tool was obtained, which had a plurality of dimples each having a diameter of  $7.5 \mu\text{m}$  and a depth of  $5 \mu\text{m}$ .

(2) Preparation of adhesive layer

An adhesive layer was made referring to Table 1, Example 2 of U.S. Pat. No. 5,143,785 (Pujol et al.), which is mentioned in paragraph 0038 of Connell.

A composition having the following formulation was homogeneously dissolved in tetrahydrofuran. The resulting solution was applied uniformly to a polyethylene terephthalate film (base film) of a thickness of  $50 \mu\text{m}$  with a bar coater and dried in a drying machine at  $60^\circ\text{C}$  for 20 minutes to form an adhesive layer. The resulting adhesive layer had a thickness of  $20 \mu\text{m}$ .

Formulation

Polyvinylbutiral BX-L	13.22 g
Cyanate ester resin B-30	13.22 g
Cyclopentadienyl iron dicarbonyl dimer	0.15 g
3-Glycidoxypropyltrimethoxysilane	0.30 g
Tetrahydrofuran (solvent)	70.11 g

With respect to useful adhesive compositions, Connell in paragraph 0038 mentions several U.S. Patent references and then describes "These patents describe adhesive compositions formulated to be one-part, curable materials formable into pliable films having low or no

tackiness before cure". This means: The adhesive power of the adhesive layer is preferably strong for the purpose of preventing dropping of the conductive particles when removing the conductive adhesive from the dimpled tool, while the adhesive power is preferably weak for the purpose of efficiently removing the adhesive from the surface of the dimpled tool and for the purpose of efficiently peeling a base film off the tool. The undersigned declarant, therefore, believes that the selection of the adhesive layer in this experiment was proper in light of the disclosure of Connell.

(3) Filling dimpled tool with conductive particles, application of adhesive layer and removal of conductive adhesive layer

An experiment was conducted in the same manner as described in paragraphs 0047 to 0050 of Connell. A series of steps are illustrated in the schematic picture of Fig. 2 attached hereto.

Conductive particles (gold-plated plastic particles, average particle size (AVE):  $5\text{ }\mu\text{m}\phi$ , standard deviation (SD):  $0.25\text{ }\mu\text{m}$ ,  $\text{SD/AVE} = 5\%$ , corr. to "gold-coated polymeric spheres" in paragraph 0064 of Connell) were scattered onto the dimpled tool and rubbed with a brush. Fig. 3 is an optical micrograph showing the surface of the dimpled tool filled with the conductive particles. The adhesive layer was pressed three times onto the conductive particles by a hand roller so that the former and the latter were contacted and adhered to each other, and then the resulting "conductive" adhesive layer was peeled off the dimpled tool. The result of the peeling is shown in the following table. The optical micrographs of the adhesive layer and the dimpled tool both after transfer are shown in Figs. 4 and 5 attached hereto, respectively.

DIMPLE DEPTH	Percentage of dimples with one particle per site	Substantial transfer rate of particles	Remaining dimples with one particle per site	Dropping of particles after removal of adhesive layer
5 $\mu$ m	99%	15%	53%	31%

A set of twenty(20) particles was arbitrarily selected in the obtained anisotropic conductive adhesive sheet. Distances between each of the twenty particles and the closest six(6) particles to said each particle were measured to obtain the average as a whole. The average distance was 40.3  $\mu$ m, that was 8.06 times the average particle size of the conductive particles 5.0  $\mu$ m. This size did not meet the limitation "the average particle distance between adjacent conductive particles is at least once but five times or less the average particle size and not greater than 20  $\mu$ m" according to claim 1 of the present application.

#### Consideration

The relationship of the above result with the present invention can be considered as below. The conductive particles might be able to be placed substantially in a rate of one particle per particle site in the dimples in accordance with the disclosure of Connell. However, when the conductive particles were tried to be transferred to the adhesive layer, the resulting adhesive sheet did not meet the limitations according to claim 1 of the present application: "90% or more of the conductive particles are present without contact with other conductive particles" and "the average particle distance between adjacent conductive particles is at least once but five times or less the average particle size and not greater than 20  $\mu$ m". No anisotropic conductive adhesive sheet of claim 1 of the present application could be

obtained according to the disclosure of Connell.

On the other hand, when the depth of the dimples is less than the particle size of the conductive particles, it would be difficult to place one particle per particle site in the dimples. Contrarily, when the depth is larger than the particle size of the conductive particles, it would be difficult to transfer the particles to the adhesive layer although it might be possible to place one particle per particle site. After all, no anisotropic conductive adhesive sheet of claim 1 of the present application could be obtained according to the disclosure of Connell.

Fig. 1 : SCHEMATIC PICTURE OF PREPARATION OF DIMPLED TOOL

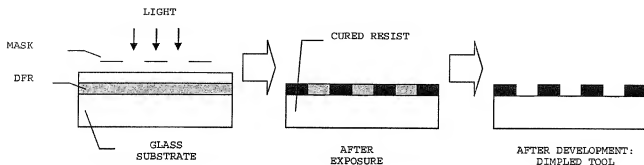


Fig. 2: SCHEMATIC PICTURE OF FILLING DIMPLED TOOL WITH CONDUCTIVE PARTICLES, APPLICATION OF ADHESIVE LAYER AND REMOVAL OF CONDUCTIVE ADHESIVE LAYER

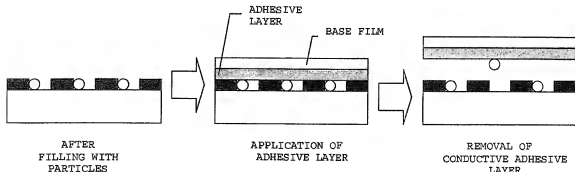


Fig. 3: DIMPLED TOOL FILLED WITH CONDUCTIVE PARTICLES (OPTICAL MICROGRAPH)

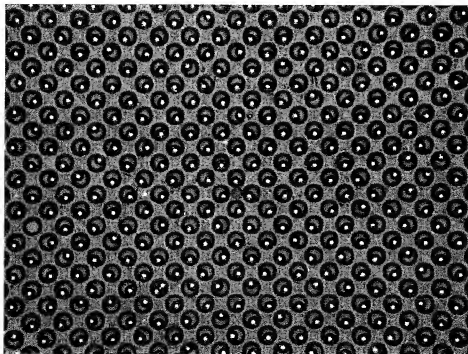


Fig. 4: ADHESIVE LAYER AFTER TRANSFER (OPTICAL MICROSCOPE PICTURE)

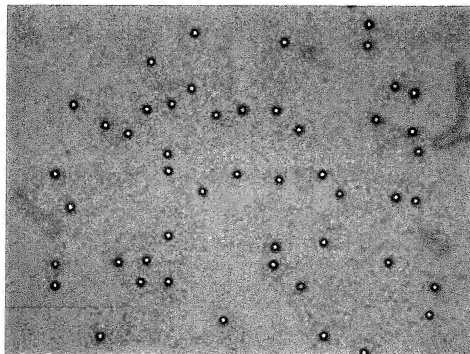
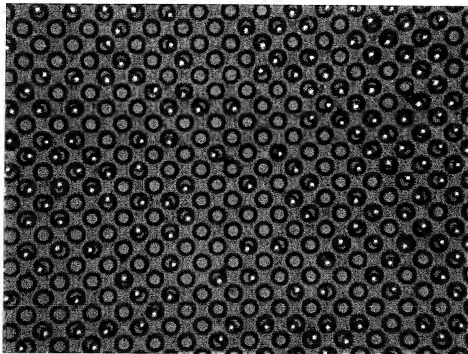


Fig. 5: DIMPLED TOOL AFTER TRANSFER (OPTICAL MICROGRAPH)



The undersigned declarant declares further that all statements made herein of his own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Signed this 26 day of June , 2009.

Akira Otani

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